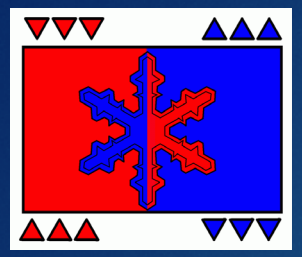

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EKONOMİ VE TEKNOLOJİ
ÜNİVERSİTESİ

Luikov's Scientific History and the Evolution of the International Center of Heat and Mass Transfer (ICHMT)

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- Aleksei Vasil'evich Luikov was born in 1910 in Kostroma. After his graduation from the Physicomathematical Department of the Yaroslavl' Pedagogical Institute in 1930, he worked in Yaroslavl' as a teacher at the Power Engineering Faculty for Workers, and then as a research scientist at the Drying Laboratory of the All-Union Heat Engineering Institute.
- At the Drying Laboratory, he conducted his first investigations into the kinetics of drying and the development of methods of determining the thermophysical characteristics of moist materials.

- In 1931, he received his first inventor's certificate for his invention "Alternating-Pressure Dryer" for work completed on the dehydration of moist porous materials at alternating vapor pressure.

- Beginning in 1931, A. V. Luikov developed rapid methods for comprehensive determination of thermophysical characteristics from one short experiment. They were used to discover and study the anisotropy of heat conduction of dispersed materials and polymer solutions due to the flow.

- As early as in 1932, to analyze the kinetics and dynamics of the process of drying, A. V. Luikov conducted experiments to investigate the moisture-content fields in convective drying of capillary-porous bodies (filter paper disks).

- On the basis of the experiments conducted, A. V. Luikov was first to propose temperature curves for the analysis of the kinetics of a drying process, including the study of the mechanism of deepening of the evaporation zone.

- In 1932, A. V. Luikov enrolled in the post-graduate school at the Scientific-Research Institute of Moscow University, where at that time worked with well-known scientists who had a great influence on the formation of his creative abilities and further scientific activities.

- In 1932-1935, A. V. Luikov worked long and fruitfully on the problem of transfer in colloidal and capillary-porous bodies. He developed a new method to determine the thermophysical characteristics of moist materials.

- In 1935, he discovered a new phenomenon - thermal diffusion of moisture in capillary-porous bodies. This fundamental work by the young scientist became widely known in the USSR and abroad. It was reported at a panel of the London Royal Society and published in its transactions.

- In the literature, the phenomenon of heat and moisture conduction is known by the name of the Luikov effect. In 1935, A. V.Luikov successfully defended his dissertation for a candidate's degree (PhD thesis) on this subject.

- All the experimental and theoretical material on the mechanism of the process of drying accumulated in the pre-war period was systematized by A. V. Luikov and was published in 1938 in the monograph "The Kinetics and Dynamics of the Processes of Drying and Moistening."

- While working on general problems of heat and mass transfer, A. V. Luikov, in particular, devoted himself to the theory of heat conduction and to the development of efficient methods of solving problems of non stationary heat conduction by the Laplace- Heaviside operational method.

- V. Luikov developed a new method of solving nonlinear problems of the theory of heat conduction, when thermophysical characteristics depend on the coordinates. This extensive cycle of works was generalized in a A.V. Luikov's new classical book "Theory of Heat Conduction" which went through two editions in the Union of Soviet Socialist Republics (USSR) and was translated in many countries.

- As a result of the hard work, A. V. Luikov was taken seriously ill and he went through a complicated operation, restricted to his bed but he continued to work fruitfully by hand; he wrote two monographs, one on the kinetics and dynamics of drying process and the other on heat conduction and diffusion.

- After recovering in 1939, A.V. Luikov defended a Thesis for a doctoral degree at the Moscow Power Engineering Institute. In 1960 he was confirmed in the title of professor.

- Since 1942, he had been in charge of the Department of Physics at the Technological Institute of the Moscow Institute of Chemical Machine-Building that he also headed, combining these two jobs. These laboratories performed extensive widely publicized research on heat and mass transfer in dispersed and capillary- porous bodies during phase change and chemical reactions.

- In the last years of his life A. V. Luikov had, among other things, a profound enthusiasm for a set of problems that was conventionally referred as "*nonlinear thermodynamics*." Included here were questions of the thermomechanics and thermodynamics of media with complicated properties: such as micro polar media, media with memory of various types, first of all the theory of heat conduction with memory. In the latter he was above all interested in the generalizations and the thermodynamic substantiation of the hyperbolic equation of heat conduction.

- During the more than 40 years of his scientific-research work, A. V. Luikov published about 250 scientific papers and 18 monographs, including "The *Theory of Drying*," "*Transfer Phenomena in Capillary-Porous Bodies*," "The *Theory of Heat Conduction*," "*The Theory of Energy and Material Transfer*," "*The Handbook of Heat and Mass Transfer and others.*

- His monographs were translated and were published in England, Germany, France, Hungary, the USA, and other countries.

- In 1951, A. V. Luikov was awarded a state prize of the first degree for his monograph "The Theory of Drying" (1950), and in 1969 he was awarded the supreme prize of the USSR in the field of heat engineering - an I. I. Polzunov prize.

- The Department of Thermal Physics that he set up at the Belarusian State University prepares highly qualified specialists-researchers in various fields of the science on heat and mass transfer.

- For 40 years, A. V. Iuikov taught at higher educational establishments and supervised the works of full time and part time post-graduate students. He prepared 130 Candidates of Sciences (PhD degree holders), and 27 of his disciples became Doctors of Sciences.

- A.V. Luikov's work in his position as the Director of the Institute of the Heat and Mass Transfer (IHMT) of the Belarusian Soviet Socialist Republic (BSSR) Academy of Sciences, of which he became head in 1956, was exceptionally fruitful. Within a short period of time a small team of 30 people grew to become a major thermophysical scientific center.

- The IHMT of the BSSR Academy of Sciences branched into the Institute of Nuclear Power Engineering of the BSSR Academy of Sciences, the Institute of Water Problems of the Ministry of Water Resources of the USSR and the Belarusian Branch of the A. M. Krzhizhanovskii Power Engineering Institute.

- In 1969, the Institute was awarded a high Government award - the Order of the Red Banner of Labor for great scientific achievements and success in the preparation of scientists.

- In 1959, Luikov was appointed as the editor of the "International Journal of Heat and Mass Transfer" on behalf of the USSR; he was Deputy Chairman of the Soviet National Committee on Heat and Mass Transfer.

- A. V. Luikov's great contribution to thermal physics enjoyed deserved recognition. In 1956, he was elected as Member of the BSSR Academy of Sciences, in 1957 - full Member of the USSR Academy of Construction and Architecture.

- In 1957 he was awarded the title of Honored Man of Science and Technology of the RSFSR. In 1967, he received the highest decoration of the country - the Order of Lenin, and in 1970, the Order of the Red Banner of Labor.

- For his scientific and international activities A.V. Luikov was honored with the USSR State Prize of the first degree in 1951, the Gold Medal “For merits in development of Friendship and Co-operation with CSSR” in 1971, and the Gold medal of the French Institute of Combustibles and Energy in 1973.

- He was elected as an Honored Foreign Member of the Mechanics Department of the Polish Academy of Sciences.

- A.V. Luikov's many valuable work were translated and published in UK, France, Germany, Hungary, the USA and other countries. There are such books as: Theory of Heat Conduction (Cambridge University Press, 1952), Experimentelle und Theoretische Grundlagen der Trocknung (Berlin, 1955), Theory of Energy and Mass Transfer (New, York, 1968).

- A. V. Luikov attached great importance to the international cooperation of scientists and constantly sought its strengthening. At the Institute, he initiated the All-Union Conferences on Heat and Mass Transfer, which have been held every four years there since 1961.

- Since 1988 they have been International Forums, which are attended by hundreds of scientists from different countries. It is not by accident that the IV. International Forum on Heat and Mass Transfer held in ay 2010 was dedicated to the 90th anniversary of A. V. Luikov's birth.

- A. V. Luikov's services to the strengthening of international ties between scientists have been recognized in many countries of the world.

- In 1969, he was elected Honorary Foreign Member of the Society of Mechanical Engineers of the Polish Academy of Sciences, in 1971 the Government of the Czechoslovak Republic decorated him with the gold medal "For Services to the Development of Friendship and Cooperation with the Cz-SSR," and in 1973, he was decorated with the Gold Medal of the French Institute of Fuel and Energy.

- His distinctly original talent, devotion to science, respect and love for people, the scientific integrity of a scientist - all this taken together, brought in wide recognition for Aleksei Vasil'evich Luikov as a public and political figure and one of the leading scientists in thermal physics.

- At present, the name of A. V. Luikov has been conferred on the Institute of Heat and Mass Transfer (IHMT) of the Academy of Sciences of the BSSR, which has been turned into a widely known scientific center by his work and the work of his followers.

- The present director of the IHMT of the Belarusian National Academy of Sciences is Academician Oleg Penyazkov (2011-present) who is well recognized scientist in heat and molecular physics, high temperature gas dynamics, chemical physics, combustion and explosions, physics of shock and detonations waves and optical gas flows diagnostics.

Important Int. conferences leading to the Establishment of the ICHMT:

- A.V. Luikov is the real founder of the ICHMT from IHTI (International Heat Transfer Institute) and IHMT.

- International meetings leading to the establishment of the ICHMT organized by Luikov and with his close friends:

- In June 1961 the first All-Union Heat and Mass Transfer Conference was held in Minsk and Professor A.V. Luikov as the Conference Chairman invited a number of distinguished foreign scientists; M.A. Styrikovich, A.N. Leontiev, S.S. Kutateladze (USSR), Ernest R.G. Eckert,Warren M. Rohsenow, J.P.Hartnett, T.F. Irvine,Jr.,(USA), Y.Mori,T. Mizushina (Japan), Ulrich Grigul, K.Stephan, E.Hahne (West Germany), D. B. Spalding, W.B.Hall (UK) and others were there.

- The Second International Conference on Heat Transfer was held in London in January 1962 and a large delegation from USSR headed by Prof. A.V. Luikov attended this meeting and has a chance for discussions about the ICHMT's foundation.

- The Committee of the Third International Conference of Heat Transfer (representatives of Great Britain, Canada, France, Germany, Japan and USSR) held in Chicago (12 August 1966) recommended to organize a special meeting to establish an Assembly for International Heat Transfer Conferences.

- The main goal of such Assembly was to plan and coordinate international conferences of heat and mass transfer.

- Following the suggestion of Prof. A.V. Luikov and Prof. E. Brun, the meeting was organized in Paris, France on April 3, 1967. Prof. L. Vasiliev was one of his first Ph. D students from Belarus, and now he is a well known scientist who also attended this meeting as the assistant of Prof. A.V. Luikov.

- The Second All-Union Heat and Mass Transfer Conference were held in Minsk in 1964 and the third such Conference was in Minsk in 1968 (see photos).

- Luikov included proposal to create ICHMT in the meeting of the Presidium of USSR and France (Prof. Edmund Brun) in Moscow.

- He wanted a center at a location such that scientists from East and West can meet together to discuss the developments in the field, exchange ideas and increase the relations between young scientists for further research without boundaries. For this purpose, they were looking for a suitable location where scientists from East-West can meet.

- The father of a well-known Prof. Mikhailov from Bulgaria was an ambassador of Bulgaria in Paris. He met with Prof. Edmond Brun, and he also proposed that Julio Curie Home of the World Scientific Organization in Varna can also be home for the new center, since in the creation of ICHMT Varna existed in both Russian and French proposals.

- Profs. Brun and Luikov proposed the establishment of theoretical part of the Institute on the Adriatic coast and the experimental part in Paris. Prof. Spalding was one of the very active persons on this matter, and he was in favor of only on the theoretical Institute on the Adriatic coast. USA, Great Britain, Presidium of the USSR with the member Prof. M. A. Styrikovich, and Ulrich Grigul, West Germany agreed in 1968 that the secretariat of the IHTI would be located in Belgrade.

- Then, with the strong leadership of Z. Zaric and later Naim Afgan, from the Serbian Academy of Sciences, IHTI became ICHMT which would become internationally known center, with Prof. Brun becoming the first president of ICHMT (1968-1972). Let us remember that although Yugoslavia was within USSR, the President Tito's policies were rather independent.

- The Center organized seminars and symposiums every year in the very beautiful historical city of Dubrovnik on the Adriatic coast and it became a well-known center in the field of heat mass transfer with many industrial applications.

- At the Middle East Technical University in the Department of Mechanical engineering, we already have a strong heat transfer group and my colleagues and I, we used to present papers there. One of the meetings was organized by Prof. Franz Durst and I presented a paper on the “two-phase flow instabilities and heat transfer” in Dubrovnik.

- I, Prof.Kakac, was representing Turkey in the NATO Science Committee. I created NATO Advanced Study Institutes on the Applied Sciences and Engineering, which is financially supported by the NATO Science Committee. I organized the First NATO ASI on the Two-Phase Flow Boiling Instabilities in Istanbul in 1976.

- Then, Dr. Kakac organized, as the director of the NATO ASIs in 1976-2009, regularly every two years on the important topics of thermal-fluid sciences, fundamentals and applications. In these Institutes, scientists from East and West met usually in Ankara, Istanbul and Cesme/Izmir, Turkey, as lecturers and participants similar to the ones organized by ICHMT in Dubrovnik.

- Zaric and Afgan also joined some of these NATO ASIs. I was invited by Z. Zaric and N.Afgan to be in the Scientific Council of the Center, and I was involved in many activities of the Center.

- ICHMT's Secretariat stayed in Belgrade 24 year until 1990. Then, a political turmoil started in the former Yugoslavia and the Secretariat was not functioning properly. Therefore, the Executive Committee of the ICHMT began to locate the secretariat in a new country.

ICHMT at METU-Ankara

- I was collaborating with Prof. Franz Mayinger, Art Bergles and other recognized scientists in organizing NATO ASIs, and Prof. Mayinger was the chairman of the executive committee (1990-1992).

- During 1990, Prof. Bergles and I, we were often visiting Prof. Mayinger, at the well-known chair of thermodynamics- A at the Munich Technical University as the recipient of the Humboldt-Preize.

- I brought the idea of locating the Center in Ankara at the Middle East Technical University (METU), and I promised that I will be able to get the necessary financial support from the Turkish Science Foundation (TUBITAK), METU and from the Turkish government.

- Prof. Mayinger and Bergles gave me a green light, to prepare a proposal to the EC of the ICHMT. At that time, I was at the University of Miami, as chairman of the department of the mechanical engineering.

- For this purpose, I came to Ankara, in August, to talk to the authorities on this matter. Fortunately, most of the decision makers were either my former students or close colleagues. I talked to the Prof. Saatcioglu, the president of METU, then I went to the President of TUBITAK Prof. Kemal Gürüz; he said right away "I will provide the necessary support".

- Meantime, Prof. S. Sevuk became the president of the METU; I talked this matter with him, he was very happy with my proposal, and promised to give full support.

- Meantime, I was also in touch with Prof. Mori, the President of ICHMT. The question was who will be the General Secretary of the center; Prof. Naim Afgan was working in Portugal as a visiting Prof., I approached him if he could join to the department of the Mechanical Engineering at METU but, he refused, and I got the impression that he wanted to locate the Center in Portugal.

- Then I started looking around for potential candidates. Former chairmen of the department and my former students came to my mind, Profs. Ediz Paykoç, Rüknettin Oskay, Orhan Yesin, and I added Faruk Arınc who was working in the computing department of YÖK (Board of Higher Education). I called them for a meeting at the Department of Mechanical Engineering. I explained the case and the responsibilities of the secretary general of the Center.

- After a small questions and discussions, Faruk said, yes I am interested in this job, the others were rather reluctant. I was very happy, because of his ability in computing, as one of my former students, knowing his abilities and his perfect personal relations with his friends, then; I agreed to nominate Faruk happily for the position, in preparing a proposal to the EC of the ICHMT.

- I also got an appointment from Prof. Erdal Inonu who was the vice Prime minister in the Demirel's government, and my close friend from METU; TUBITAK was under Prof. Erdal Inonu for all decisions. Prof. Inonu is a well-known scientist in physics and was very happy with my activities on this matter; then I went back to Prof. Gürüz and asked him if he could call Prof. Mayinger, Chairman of the EC, telling him your full support for the center, and he did, and Prof. Mayinger asked him to prepare a proposal for the next meeting of the EC to be held in Rome, in September.

- Prof. Gürüz is very well aware of the Center, and he mentioned to me that he presented papers in Dubrovnik meetings. Gürüz was our former student in the Department of Chemical engineering at METU when I was Assoc. Prof. in the department of mechanical engineering. I asked him, please go to the EC meeting in Rome with Faruk Arınc, and present this excellent proposal that agreed by TUBITAK, METU to locate this important Center in the department of the mechanical engineering at METU, Ankara.

- I would like to mention that Department of Mechanical engineering was well known within the heat transfer community, since most of the well-known scientists in the field came to the department as visiting Professor/invited speaker, as well as invited lecturers in the NATO ASIs.

- There were other countries wanted to locate the Center. After organizing these, in August I went back to Miami to start the new semester. I was in touch with Prof. Mayinger and Bergles on this matter, and then I learned from Mayinger that, after long discussions EC agreed on Ankara to be new home of the Center.

- Since 1993, Prof. Arınç as the Secretary General of the Center, with the traditional activity of organizing Int. Symposia and Seminars, publishing many volumes of Proceedings in the field of heat mass transfer with applications continues to be a well-known a unique Center.

- The CENTER will celebrate 50th Anniversary in 2017-2018. A committee has been setup within the EC of The CENTER headed by Prof. K. Hanjalic to identify new future actions and activities of the CENTER in the light of the scientific and technological developments with great applications of heat and mass transfer for further developments in science-technology and education in the field for the next 50 years.

Aleksei Vasilievich Luikov, founding member of IHMT at Belarusian National Academy of Sciences, initiator of the International collaboration in the field of HMT.

Edmund Brun, First Chairman of the ICHMT (1968-1972), member of the French Academy of Sciences, Director of the Scientific Board on Heat and Mass transfer establishment, chairman of the laboratory on Aerodynamics, 1974

Professor M.D. Mikhailov, Bulgaria. One of the scientists, closely cooperating with academician A.V. Luikov in the theory of heat and mass transfer in capillary-porous media on the day of his 70th birthday.

A.V. Luikov and Edmund Brun in a press conference, 1968.

Scientists from West-East: Brian Spalding (UK), Edmund Brun (FR), Tom Irvine (USA), P. Lebedev (USSR), 1968

Brian Spalding, A.V. Luikov, his wife Nina Fedorovna Luikov, and other members of the Int. conference, 1968

A.V. Luikov with his students at Belarusian National Academy of Sciences, 1972

Academician Oleg Peniazkov, member of the National Academy of Sciences of Belarus, Member of the Scientific Council of the ICHMT,

Director of the Luikov IHMT of National Academy of Sciences of Belarus, Minsk-2011-present, head of the department of Physics and Chemistry of Nonequilibrium Media

Prof. L. Vasiliev, first Ph.D. student of Luikov from Belarus, Chief researcher of the Luikov IHMT at Minsk, President of the CIS Association Heat Pipes; member of the Scientific Council of the ICHMT.

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- TOBB University of Economics and Technology.

References

1. O.G. Martynenko, Luikov's Scientific Legacy, Jepter, Vol. 5 Number 5, 2000.
2. Personnel communications with, Leonard L. Vasiliev, Belarus, National Academy of Sciences, Minsk Belarus.
3. Personnel communications with, Academician O. Penyazkov, Director of the Luikov HMT Institute at the Belarusian National Academy of Sciences, Minsk, Belarus.
4. Personnel communications with M.D. Mikhailov, TU-Sofia, Bulgaria.
5. Personnel communications with F. Mayinger, Technical University of Munich.
6. Personnel communications with A.N. Leontiev, State University of Moscow.
7. J.P. Hartnett, Origin of the ICHMT, www.ichmt.org.tr.
8. Personnel communications with K. Guruz, METU
9. F. Arınç, Development of ICHMT, METU, Booklet of the Center, 2011.